IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Brad A. Armstrong	Docket No.:	F2811
Serial No.:	10/773,025	Art Unit:	2629
Filed:	February 4, 2004	Examiner:	William Boddie
For:	Image Controller		

DECLARATION OF BLAKE HANNAFORD, Ph.D.
PROVIDED UNDER 37 C.F.R. § 1.132

1. My name is Blake Hannaford, I am over 21 years of age, and make this declaration based upon my own personal knowledge. All of the statements contained herein are, in all things, true and correct.

Background and Qualifications

2. Since 1989, I have been a faculty member in Electrical Engineering at the University of Washington. I have been a full professor since 1997 and have adjunct appointments in the Bioengineering, Mechanical Engineering and Surgery Departments.

3. I received my Bachelors degree in Engineering and Applied Science from Yale University in 1977 and my MS and Ph.D. degrees, in Electrical Engineering, from the University of California, Berkeley, in 1985. I was employed as Technical Group Supervisor of the Man-Machine Systems and Human Factors Group, Automated System Section, at the Caltech/NASA Jet Propulsion Laboratory (JPL), from 1986-1989.

4. My training and research have included experience and published research in telerobotics, haptics, mechatronics, human robot interaction, robotics, and biomedical signal processing among other topics. I received the Early Career Achievement Award from IEEE's Engineering in Medicine and Biology Society, and I was named a Fellow of the IEEE in 2005. My current research focus is in the areas of haptic (touch enabled) computer and robot interfaces and surgical robotics. I have been a consultant to the FDA surgical devices panel in its consideration of safety and effectiveness of surgical and rehabilitation devices. I have

designed and supervised the design of multiple haptic devices: electromechanical devices that a user manipulates to control remote or simulated objects and that optionally provide force feedback to the user's hand or fingers.

Retention as Expert Witness

5. I have been retained by Anascape, Ltd. to review documents associated with the United States Patent and Trademark Office's ("USPTO") examination of U.S. Patent Application serial no. 10/773,025 ("the '025 Application"). I understand that Anascape, Ltd. is the assignee of the '025 Application. More specifically, I have been retained to identify and present rebuttal evidence in response to the USPTO's rejection of the pending claims as set forth in the Office Action dated May 19, 2009.

6. I am being compensated at my standard hourly consulting rate for my work on this project. My compensation and the terms of retention as an expert witness are not contingent upon the nature of my findings or the outcome of any matters at issue in the '025 Application or any other Anascape, Ltd. patent application. Prior to my retention for this project, I previously prepared a Declaration in Anascape, Ltd.'s pending patent application no. 11/150,412.

7. While preparing this Declaration, I have worked with Michael Fogarty, Anascape Ltd.'s attorney. Mr. Fogarty provided copies of the following documents for me to review:

   - Patent application publication US 2004/0160414 A1, which includes the specification and drawings of the '025 Application as filed;

   - The claims of the '025 Application as pending following the Supplemental Amendment filed on February 27, 2009;

   - USPTO Office Action for the '025 Application dated May 19, 2009;

   - U.S. Patent No. 4,493,219 to Sharp;

   - U.S. Patent No. 5,298,919 to Chang;

- U.S. Patent No. 5,589,893 to Gaughan; and

- U.S. Patent No. 5,724,106 to Autry.

Application Serial No. 10/773,025

8. I have read the disclosure of the '025 Application and reviewed the accompanying drawings.

9. I understand that the '025 Application is a continuation-in-part of U.S. Patent Application serial no. 09/893,292, which was filed on June 26, 2001 and issued as U.S. Patent No. 7,345,670; that Application serial no. 09/893,292 is a continuation of U.S. Patent Application serial no. 09/721,090, which was filed on November 21, 2000 and issued as U.S. Patent No. 6,310,606; and that Application serial no. 09/721,090 is a continuation of U.S. Patent Application serial no. 08/677,378, which was filed on July 5, 1996 and issued as U.S. Patent No. 6,222,525. Accordingly, I understand the priority date for the '025 Application to be July 5, 1996.

10. I understand that the claims pending in the '025 Application will be amended as indicated below. Therefore, I have based my analysis on the below-listed claims.

1-8. (Canceled)

9. (Currently Amended) An image controller allowing control of an image generation device capable of creating three-dimensional imagery, the image controller comprising:

a single input member capable of being manipulated in six degrees of freedom by a human hand <u>to control movement of the three-dimensional imagery in six degrees of freedom</u>;

a circuit board having an upper surface and a lower surface;

a first proportional sensor located on the upper surface of the circuit board, the first proportional sensor indicates manipulation of the single input member;

a secondary input member capable of being controlled by the human hand

to effect bidirectional movement of the three-dimensional imagery on at least one axis independent of the control of three-dimensional imagery by the single input member;

two additional sensors located on the upper surface of the circuit board, the two additional sensors indicate the bidirectional movement of the secondary input member;

one additional sensor located on the lower surface of the circuit board;

a second proportional sensor indicating rotation of the single input member;

two button sensors located on the upper surface of the circuit board control at least a volume function;

one button sensor located on the upper surface of the circuit board controls an ON/OFF function;

a transmitter allowing wireless communication of information from the controller to the image generation device, the information is useful to control the image generation device; and

a battery compartment adapted to hold a battery for powering the image controller.

10. (Previously Presented) The image controller of claim 9, wherein said first proportional sensor is of a capacitive type.

11. (Previously Presented) The image controller of claim 9, further comprising:

two button sensors located on the upper surface of the circuit board control channel switching.

12. (Currently Amended) An image controller allowing control of an image generation device capable of creating three-dimensional imagery, the image controller comprising:

a single input member capable of being manipulated in six degrees of freedom by a human hand to control movement of the three-dimensional imagery in six degrees of freedom;

a circuit board;

a first proportional sensor located on the circuit board, the first proportional sensor indicates manipulation of the single input member;

a secondary input member capable of being controlled by the human hand to effect bidirectional movement of the three-dimensional imagery on at least one axis independent of the control of three-dimensional imagery by the single input member;

two additional sensors located on the circuit board, the two additional sensors indicate the bidirectional movement of the secondary input member;

two button sensors located on the circuit board control at least a volume function;

one button sensor located on the circuit board controls an ON/OFF function;

a transmitter allowing wireless communication of information from the controller to the image generation device, the information is useful to control the image generation device; and

a battery compartment adapted to hold a battery for powering the image controller.

13. (Previously Presented) The image controller of claim 12, wherein said first proportional sensor is of a capacitive type.

14. (Previously Presented) The image controller of claim 12, further comprising:

two button sensors located on the circuit board control channel switching.

15. (Previously Presented) The image controller of claim 13, further comprising:

a second proportional sensor indicating rotation of the single input member.

Level of Ordinary Skill in the Art

11. It is my opinion that the relevant art is in the combined fields of electrical engineering, mechanical engineering, and user interface design, otherwise known as "haptic device engineering" or "physical human-robot interaction". It is my opinion that a person of ordinary skill in this area would normally have a Master's degree in bioengineering, electrical engineering, or mechanical engineering. Alternatively a Bachelor's degree in electrical engineering, mechanical engineering or bioengineering with significant job experience in haptic interface design, haptic device engineering or physical human-robot interaction.

Analysis of May 19, 2009 Office Action

12. I have reviewed and analyzed the USPTO Office Action dated May 19, 2009 ("Office Action") and the references cited therein (Sharp, Chang, Gaughan, Autry). The following is an analysis of the claim rejections detailed starting on page 2 of the Office Action. The Office Action rejects pending claims 9-15 over a combination of the Sharp, Chang, Gaughan, and Autry references.

The Chang Patent

13. The Office Action states that the Chang patent discloses an image controller comprising a single input member (identified as trackball 32 of mouse 10) that is capable of being manipulated in five degrees of freedom (i.e. 5 DOF). (Office Action at 2). The five degrees of movement for trackball 32 are listed as: two degrees of lateral movement (X-Y movement across the surface on which mouse 10 rests) and three degrees of rotational movement.

14. I note that some of the differences between the Chang patent and the invention claimed in the '025 Application are identified and discussed at length in the '025 Application itself at page

6, third paragraph to page 9, first paragraph. In particular, at page 9, in the first paragraph, the '025 Application states: "The Chang controller does not have a single input member such as one ball or one handle which can be operated (causing representative electrical output) in six degrees of freedom." The claimed "single input member" of the '025 Application must be operated to cause representative electrical output in six degrees of freedom.

15. Neither mouse 10 nor trackball 32 are a "single input member" as described in the '025 Application or as required in the claims. Claims 1 and 13 require "a single input member capable of being manipulated in six degrees of freedom by a human hand to control movement of the three-dimensional imagery in six degrees of freedom." Although trackball 32 could be picked up and moved in six degrees of freedom in space, it does not provide or receive inputs for all six degrees of freedom. Trackball 32 only receives inputs for three rotational inputs. (See, Chang at column 6, lines 15-25).

16. A rigid object moving around freely in space (such as tumbling in the air) has six degrees of freedom including three translations (commonly labelled X, Y, Z) and three rotations, (commonly labeled as roll, pitch, yaw, or as ZYZ Euler angles, or using other methods to indicate rotation). The trackball in Armstrong's invention is a single rigid body which provides signals representing these six degrees of freedom when operated by a user. In contrast, Chang's device has six degrees of freedom only when three different rigid bodies, the two trackballs (32, 22) and the rotary wheel (26), are moved in combination.

17. It is known to those skilled in the art that when engineering articulated mechanical systems with multiple degrees of freedom, especially within the size, weight, and cost constraints of a hand-operated consumer device such as Chang's mouse 10, the difficulty increases significantly as each degree of freedom is added. Much of this difficulty comes from integrating the degrees of freedom to avoid placing constraints on their combined motion. An easy way to avoid constraints between the degrees of freedom is to make them separate moving bodies, such as the Chang mouse 10. For example, an extremely simple six degree of freedom input device would be a box with six knobs on it. However this would lack any integration and, therefore, not allow combined rigid-body type motion. The human must

convert desired rigid body motion (for example, of a 3D object controlled on a computer screen) into a set of motions of the six knobs.

18. Chang's device consists of two entirely separate tracked spheres (32, 22) and a tracked wheel (26). In principle, each sphere potentially has three degrees of rotation freedom but no degrees of translation in this device since it is constrained by the housing. However, Chang's device only senses two degrees of freedom of the lower sphere (22), as commonly done in computer mice which track XY position through rotation of a bottom-mounted sphere. Chang's device senses three degrees of freedom in the upper sphere (32). Chang's mouse 10 provides a sixth degree of freedom along the Z-axis using wheel 26. Thus, although exhibiting a total of six degrees of freedom, Chang lacks the comprehensive integration evidenced by Armstrong's invention.

19. Because of this integration, a user of Armstrong's device (for example Armstrong's trackball 12; Figure 5), wanting to achieve a certain rigid body motion of a remote or simulated object, simply moves the sphere (e.g. trackball 12) in that exact way. The user can grip the sphere and both translate and rotate it with one finger placement. In contrast, the user of Chang's device must re-place their fingers, on the device body to achieve XY translation (using trackball 22), and then on to the upper sphere (32) to achieve orientation, and perhaps also re-place their fingers to operate the wheel (26) to achieve Z-axis translation.

20. Although it might be possible for a user of the Chang mouse 10 to learn to do this using groups of all five fingers on different surfaces, it would be much more likely that a user would first move the mouse body in the plane, then move the separate sphere, and third, move the rotary wheel, or perhaps do these separate actions in any order. These three inputs are not a "single input member" as claimed in the '025 Application. The extra integration engineering evident in Armstrong's invention gives the user a more intuitive interface. As a result of these considerations, 1) it would not be obvious to one of ordinary skill in the art to combine features of Chang's more loosely integrated separate system into Armstrong's more complexly integrated system, and 2) one or ordinary skill in the art would not consider Chang's mouse to be analogous art because it contains a lower level of integration of the six

motion degrees of freedoms and thus requires more elaborate user motions to achieve the same function.

21. The Office Action characterized trackball 32 as a five degree of freedom device. Trackball 32 could also be moved vertically in a Z-axis direction off the surface just as it could be moved in the X- and Y-axes across the surface as suggested by the Office Action. However, trackball 32 has no capability to provide an electrical output or other signal representing such lateral X-, Y-, or Z-axis movement. Accordingly, trackball 32 is a single input member device providing three degrees of freedom.

22. The Office Action states that Chang does not expressly disclose a sixth degree of freedom. (Office Action at 3). This is not correct. The Chang mouse 10 is a multiple input member that requires inputs to three "locating members 16, 18, 20" to provide six degrees of freedom control. (Chang at column 4, lines 18-37). One of ordinary skill in the art would understand the description of Figure 1-5 to describe a multiple input device for controlling six degrees of freedom. Alternatively, one of ordinary skill in the art would understand Chang to disclose three single-input devices controlling three (trackball 32), two (trackball 22), or one (wheel 26) degrees of freedom.

23. Claims 1 and 13 require "a secondary input member capable of being controlled by the human hand to effect bidirectional movement of the three-dimensional imagery on at least one axis independent of the control of three-dimensional imagery by the single input member." The Office Action describes trackball 22 as a "secondary input member." (Office Action at 3). I disagree with this characterization of trackball 22. One of ordinary skill in the art would understand trackball 22 to be used to provide two degrees of freedom as part of a multiple input device. (Chang at column 4, lines 18-37). The Chang patent describes the use of trackball 22 to control the same object, such as a cursor, that is being controlled by trackball 32 and wheel 26. Accordingly, trackball 22 is not a "secondary input member" as required in claims 1 and 13.

The Gaughan Patent

24. The Office Action states that Gaughan discloses the addition of a sixth degree of freedom to a trackball as shown by the down arrow in Figure 6. (Office Action at 3).

25. The description of Gaughan's Figure 6 begins at column 4, line 14. Trackball 42 may be depressed to activate switch 44. (Column 4, lines 35-37). Switch 44 sends an activation signal that causes cursor 56 on a CRT screen to illuminate. (Column 4, lines 42-47). Gaughan shows that trackball 42 may move along a lateral axis, but trackball 42 does not provide an input that would control movement of imagery.

26. Switch 44 provides a binary on-off activation signal. This signal does not provide an input or control for one of six degrees of freedom. Even if the activation of switch 44 was used to indicate desired movement along a lateral axis, that movement would only be in one direction. For example, when depressed or activated, a signal from switch 44 may be used to command movement in one direction along a lateral axis. However, there is no corresponding movement in the opposite direction along the lateral axis. When switch 44 is deactivated or released, no signal would be sent, which may correspond to either no movement along the lateral axis. Accordingly, if switch 44 was used to provide a lateral axis or degree of freedom input, the imagery would only be able to move in one direction along that axis. At best this provides one-half of a degree of freedom on the axis.

27. One of ordinary skill in the art would not interpret the activation of switch 44 as providing an input along a degree of freedom. Further, one of ordinary skill in the art would not be motivated to combine the Gaughan trackball with the Chang mouse. Despite the Office Action's characterization of the Chang mouse 10 as having five degrees of freedom, the Chang description teaches that the mouse 10 already provides a multiple input six degrees of freedom device. (See. Chang column 4). Therefore, one of ordinary skill in the art would not need to add the activation switch 44 of Guaghan to introduce a sixth degree of freedom to Chang's mouse 10.

The Autry Patent

28. The Office Action describes the TV remote control in the Autry patent as containing a sensor located on the bottom of the circuit board. In considering the claims of Armstrong, the terms "top" and "bottom" of the printed circuit board (PCB) should be interpreted with respect to the location of the human interface device, or equivalently, the location of the relevant human limb or hand. Autry's remote control shows a trigger element (to be used in contact with a human finger) on the lower side of the remote control. It is this human interface element and only this human interface element, which operates a sensor on the lower side of the PCB. In contrast, Armstrong's invention shows a human interface element entirely on the upper side of the PCB, but sensors on both sides with certain described advantages. Thus, the term "top" in this context should be interpreted as "the same side as the user interface element," while the term "bottom" should be interpreted as "the opposite side as the user interface element." Using this interpretation Autry's device does not have any sensor mounted on the side of the PCB opposite to the human limb being detected and thus does not disclose this element of Armstrong's invention.

29. To make an obvious combination with Autry, all sensors in Armstrong's invention should of necessity be on the same side of the PCB as the human interface element while in fact, Armstrong's invention deploys a combination of sensors on both the same side and the opposite side as the human interface element.

Non-Analogous Art

30. The Gaughan and Autry patents disclose TV remote controls. For example, Gaughan describes using the trackball to select among control functions of a TV receiver on a 2D screen. Autry describes a "pointing device" inside a remote control, coupled with a trigger for remotely controlling a home entertainment system. At most, these two devices use two proportional degrees of freedom to select among TV receiver functions, select among inputs, or tune channels which would be arrayed in a 2D screen layout. Thus Armstrong's field of "hand operated graphic image controllers, and particularly six degree of freedom computer image controllers," is a different field of art and is not analogous to TV remote controllers.

31. Furthermore, Armstrong claims/discloses a spatially interactive 3D positioning and orienting device aimed at controlling the apparent position and orientation of a 3D object rendered in a graphics display in six degrees of freedom. The functions of the Autry and Gaughan patents are selecting among options, channels, and inputs in a TV receiver. Because of this difference, only 2D are needed, the level of integration can be lower, and a non-proportional, 1-bit, button click is sufficient sensing of Z-axis travel of the trackball. These differences in intended use drove the simpler designs of these devices and thus require them to be considered non-analogous art.

32. In summary, it is my opinion that one of ordinary skill in the art would not consider the technology of the Chang patent to be analogous to the disclosure of the Autry and Gaughan patents. Therefore, one of ordinary skill would not look to combine features of these diverse technologies.

Conclusion

33. In my opinion, the combination of prior art identified by the Office Action is neither obvious or predictable for one of ordinary skill in the art as of the priority date for the '025 Application, July 5, 1996. Furthermore, one of ordinary skill in the art would not interpret the cited references as teaching all of the elements of the pending claims in the '025 Application.

DECLARATION

I, Blake Hannaford, declare under penalty of perjury under the laws of the United States of America that the foregoing declaration is true and correct.

Executed on the 19th day of November, 2009 in King county, Washington.

BLAKE HANNAFORD, Ph.D.